Writing “Balanced” Nuclear Equations
When looking at the reactants and products

• Atomic numbers must balance and
• Mass numbers must balance

REMEMBER THE CONSERVATION OF MASS/MATTER LAW???
Alpha Decay

\[ ^{238}_{92} \text{U} \rightarrow ^{234}_{90} \text{Th} + ^{4}_2 \text{He} \]

Two protons and two neutrons lost

The protons and neutrons leave as an alpha particle.

Energy
Beta Emission:

\[
\begin{align*}
\frac{1}{0} n &\rightarrow \frac{0}{-1} \beta + \frac{1}{1} p \\
\end{align*}
\]

A beta particle is just like an e-. When beta decay happens, the nucleus changes a neutron into a proton and an e-, and emits the e-

\[
\begin{align*}
\text{Th} &\rightarrow \frac{0}{-1} \beta + \frac{234}{91} \text{Pa} \\
\end{align*}
\]
Gamma Radiation:

No change in atomic or mass number

\[
\text{\footnotesize{\text{\begin{array}{c}
\text{11} \\
\text{5} \\
\text{B}^* \\
\text{\rightarrow} \\
\text{11} \\
\text{5} \\
\text{B} \\
\text{+} \\
\text{0} \\
\gamma
\end{array}}}}
\]

boron atom in a high-energy excited state
Gamma rays:

Dangerous EMR waves - usually emitted with other types of radiation. They penetrate very deeply.
Balancing Nuclear Equations

\[
\frac{238}{92}U \rightarrow \frac{234}{90}Th + \frac{4}{2}He
\]

Remember that the # of PROTONS determines which ELEMENT it is!!!
Find the missing part

\[ ^{239}\text{Pu} \rightarrow ^4\alpha + ^{235}\text{Sy} \]

\[ 239 - 4 = 235 \]

\[ 94 - 2 = 92 \]

\[ ^{235}\text{Sy} \]

\[ 92 \]
Practice Problems

\[ _{19}^{40} \text{K} \rightarrow _{20}^{40} \text{Ca} + ? \]

\[ _{95}^{241} \text{Am} \rightarrow _{93}^{237} \text{Np} + ? \]
They can get weird!

\[ ^{85}_{37} \text{Rb} + ^{1}_{0} \text{n} \rightarrow ? \]

\[ ^{238}_{93} \text{Np} + 2^{0}_{-1} \text{e}^{-} \rightarrow ? + ^{4}_{2} \text{He} \]

Still just adding and subtracting!
Nuclear Fission

When atoms split into more/smaller pieces
Nuclear Fusion - Powers the Sun

\[
\begin{align*}
\text{POSITRON} & \\
\text{Like a beta particle, but positive. From breaking a proton into pieces}
\end{align*}
\]
Chain Reaction

When one particle causes an atom to break apart into multiple pieces, then each of those cause more atoms to break apart into even more pieces, over and over...
Parent and Daughter Vocab

• Parent Atom
  – What you start with

• Daughter Product (Decay Product)
  – The new atom that is made
• The daughter product of one reaction is still unstable. It will decay into a new daughter product.
  
  —The daughter product becomes a parent atom for a new reaction!
\[ {}^{244}_{94} \text{Pu} \rightarrow {}^{4}_{2} \text{He} + {}^{240}_{92} \text{U} \]

\[ {}^{0}_{-1} e + {}^{240}_{93} \text{Np} \rightarrow {}^{2}_{2} \text{He} + {}^{232}_{89} \text{Ac} \]

**FIND THE NEUTRON TO PROTON RATIO**

\[ n:p \text{ ratio} = \frac{143}{89} = 1.6 \]